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In today's society it seems that the word chemistry is admired by few and frowned upon by many. Chemistry is not only thought of as an extremely difficult academic discipline, but it is viewed as one of the main culprits in the phenomenon known as global warming. Many global warming activists, along with the general media, stress the importance of a greener world without the use of synthetically derived chemicals. There is no denying that chemistry has had many negative impacts on our planet; however, it seems many individuals have forgotten that the science of chemistry has also made many beneficial contributions to our civilization. As a society we are quick to criticize and point the blame, but maybe we should remember how important chemistry is as we take our daily medications, drink our coffee, and pick up our dry-cleaning.

Leading chemists are now taking the initiative to change modern day chemistry to help protect our environment without changing the lifestyles that everyone has become accustomed to. In a society where everything is going green, so is chemistry. Green chemistry, which is also known as sustainable chemistry, ". . . is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances" (EPA, 2009). Green chemistry is a set of guidelines that strive to make chemical products friendlier to the environment and to the health of all animals without having negative economic affects. Many products and processes are conforming to green standards including plastics. (EPA, 2009)

Plastics have become a large environmental problem. In fact, "Americans go through 25 billion plastic bottles each year" (Oberlin, 2008). Unfortunately, these plastic bottles along with other forms of plastic account for "25 percent" (Royte, 2006) of the total volume of landfills. The plastics that do reside in landfills degrade very slowly, which can cause the original products to remain in our landfills for hundreds or even thousands of years. (Oberlin, 2008)

Biodegradable plastics are becoming a new trend because they are believed to be friendlier to our environment. Biodegradable plastics are plastics that will decompose in both aerobic and anaerobic environments. Unlike conventional plastics, "a genuine biodegradable plastic will be converted to carbon dioxide, water and compost, without leaving any persistent or toxic residue" (Unmar & Mohee, 2008). Biodegradable plastics have the ability to significantly decrease the quantity of plastics within our landfills, and also eliminate toxins within our air from the burning of conventional plastics. (Unmar & Mohee, 2008)

Biodegradable plastics are made from renewable raw materials, and are presently found in various forms with different degrees of degradability. One of the most frequently used forms of biodegradable plastics is termed as *hydrobiodegradable* plastic. Unlike conventional plastics, which are comprised of polymers of high molecular weight, these hydrobiodegradable plastics are comprised primarily of starches that are found in plants or food, although some contain a small percentage of synthetic polymers. When hydrobiodegradable compounds are degraded, the original product reduces to water, carbon dioxide, methane, and biomass. (Azios, 2007)

Although methane and carbon dioxide are considered greenhouse gases, this additive effect upon the cumulative level of the planet's greenhouse gases is considered to be negligible by most researchers. This is because landfills are specifically designed to capture any released methane, so any methane released will be confined within the landfill. The carbon dioxide that is produced is also not looked at as a contributor of greenhouse gases because the plant that the hydrobiodegradable

plastic was made from consumed carbon dioxide, so the release of carbon dioxide during the decomposition is thought of as an even exchange. (Azios, 2007)

However, there are many other forms of biodegradable plastics that are still made exclusively from nonrenewable petroleum byproducts, similar to conventional plastics. This form of biodegradable plastic is termed *oxobiodegradable*. The primary difference between oxobiodegradable plastics and conventional plastics is that these products degrade more quickly. Oxodegradable plastics break down into water, carbon dioxide, and biomass when exposed to sunlight, heat, and other stresses. Oxobiodegradables do break down much quicker than conventional plastics, but they still require the same fossil fuels during their manufacture and emit the same degree of greenhouse gases as conventional plastics. (Azios, 2007)

The concept of biodegradable plastic products is an excellent example of green chemistry in theory, and adheres to many of the principles of green chemistry as set forth by the EPA. Biodegradable plastics are designed for degradation. When biodegradable products break down, they are supposed to completely biodegrade into safe natural compounds within a short period of time. Biodegradable plastics break down much more efficiently than conventional plastics, but they are also produced much more efficiently. The production of biodegradable plastics consumes ". . . 65 percent less energy than producing conventional plastics" (Royte, 2006). Biodegradable plastics have many environmental advantages, but they are also much safer for consumers. Biodegradable plastics are completely nontoxic, and they do not break down into toxic substances. (EPA, 2009 & Royte, 2006)

Biodegradable plastics seem nearly perfect in theory; however, in all practicality, biodegradable plastics are still in their infancy, and there is a lot of room for improvement. The thought of plastics breaking down into natural compounds sounds too good to be true and it is. Biodegradable plastics do not break down in natural conditions. An individual cannot create a compost pile of biodegradable plastic in their backyard and expect to watch the plastic disappear in 90 days. Biodegradable plastics require the perfect conditions in order to decompose into natural compounds. These conditions can only be achieved in a large composting facility, which most individuals do not have access to. This implies that the majority of biodegradable plastics will find local landfills their permanent residence. Since these landfills do not meet the perfect conditions that are necessary for biodegradable plastics to decompose, the biodegradable plastics will remain in the landfill for just as long as their ancestors. (Royte, 2006)

There is still a lot of confusion amongst consumers and manufacturers as to what biodegradability really means. Many consumers believe that if a product is biodegradable -- the product will just disappear on its own with little to no assistance. Unfortunately, biodegradable products require much assistance when it comes to biodegrading. As the truth continues to come out about biodegradable products many consumers are beginning to believe that this is just another case of false advertising. (Royte, 2006)

The reluctance towards biodegradable plastics does not end at their validity. Many skeptics also believe there are moral issues that need to be evaluated. The demand for land with fertile soil will increase greatly, if the production of plastics depends on plants. If the demand for fertile soil increases than so will food prices. Currently, our economy is struggling, so an increase in food prices may not be feasible. (Royte, 2006)

It is apparent that chemists are trying to change modern day chemistry to help protect our environment, but there is still a lot more work and research that needs to be done until we can successfully say that there are completely "green" plastics. The guidelines set forth by the EPA are an excellent stepping stone to start changing the negative impacts that chemistry has had on our environment, but completely green chemistry is still a distant reality.

Works Cited

Azios, T. (2007, December). A primer on biodegradable plastics. Christian Science Monitor. Retrieved from Academic OneFile database.

*Environmental Protection Agency*. (2009). Retrieved November 30, 2009, from http://www.epa.gov/greenchemistry

Oberlin College, recycling program. (2008). Recycling facts. Retrieved from http://www.oberlin.edu/recycle/facts.html#plastic

Ryote, E. (2006, August). Corn plastic to the rescue. Smithsonian. Retrieved from http://www.smithsonianmag.com/science-nature/plastic.html?c=y&page=1 Unmar, G., & Mohee, R. (2008). Assessing the effect of biodegradable and degradable plastics on the composting of green wastes and compost quality *BioresourceTechnology*, 99, 6738-6744.